

PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(54) TURBO-BLADE CRACK DETECTION MEANS

(71) We, MOTOREN-UND TURBINEN-
UNION MÜNCHEN GESELLSCHAFT MIT
BESCHRÄNKTE HAFTUNG, formerly M.A.N.
Turbo G.m.b.H., a German Company, of
5 Dachauer Strasse 665, München-Allach,
Germany, do hereby declare the invention,
for which we pray that a patent may be
granted to us, and the method by which it is
to be performed, to be particularly described
10 in and by the following statement:—

This invention relates to turbo-blade crack
detection means for a turbo machine for early
detection of turbo-blade failure caused by
incipient cracks.

15 Only in very rare cases will the failure of
blades in a turbo machine take the form of an
instantaneous complete separation throughout
the whole cross-section. Usually, an incipient
crack will occur in a particular zone in a par-
20 ticular type of blade, and then will propagate
only after a certain period of continued stress
to such an extent that a final fracture occurs.
It is this final fracture that will then cause the
secondary damage which frequently means the
25 complete destruction of the machine.

The invention aims at preventing the de-
velopment of such secondary damage by
attempting to detect an incipient crack in a
blade as early as possible.

30 Accordingly the present invention provides
a combination of a turbo-blade having a resis-
tance wire embedded therein with an electric
circuit connected to said wire and operative
to detect a change of resistance in the wire
35 due to a crack in the blade.

In a particular embodiment of the inven-
tion, the resistance wire is incorporated in a
peripherally extending region of the blade or
at least in an area of the blade which is
40 thought to be most prone to incipient cracks,
this wire normally completing the signal
circuit which will be broken if a crack occurs,
thereby triggering a signal.

45 It would be possible to connect several
blades of one stage of a turbo machine, all
blades of one stage or blades of several stages
of the machine to a common main signal cir-

cuit. These may be stator as well as rotor
blades.

Reference will now be made to the drawing 50
in which the figures are schematic presenta-
tions and

Figure 1 is a view of a blade with a warn-
ing signal circuit wire according to an embodi-
ment of the invention, 55

Figure 2 is a cross-section through the blade
of Figure 1, 60

Figure 3 is an arrangement according to an
embodiment of the invention fitted to a set of
stator blades, and 65

Figure 4 is an arrangement according to
an embodiment of the invention fitted to a set
of rotor blades.

Referring to Figure 1, in a blade 1 an area
or region marked by shading 2 is thought to 65
be especially prone to incipient blade cracks
and blade failures. A resistance wire 3 is in-
corporated in blade 1 and routed through a
peripheral blade area 2. Resistance wire 3
leaves the blade via blade root 4, and is, at
70 terminals 5, 6, connected to a circuit com-
prising an electrical warning circuit (such as
a circuit 7 shown in Figure 3) to which a sig-
nal indicating unit is connected. The indicat-
ing unit may be one with an optical or 75
acoustic warning signal. It is indexed 8 in
Figure 3.

Within area 2, the connection between resis-
tance wire 3 and blade 1 must be such that 80
resistance wire 3 will be broken when a blade
crack occurs in area 2, an example for such a
blade crack being shown by line 9. When this
blade crack 9 occurs, the resistance in the
warning circuit is suddenly and considerably
increased, thus triggering the warning signal. 85
In this way it will be possible to readily
detect a blade crack from the outside and to
remove and replace the blade before a blade
failure with the possible consequent destruc-
tion of the complete machine. 90

In the embodiment of Figure 3 all blades
1 of a stator are connected to the common
warning circuit 7 with indicating unit 8,
and in the embodiment of Figure 4, all blades

[Price 25p]

1 of a rotor are connected to a slip-ring contact 9'.

WHAT WE CLAIM IS:—

- 5 1. A combination of a turbo-blade having a resistance wire embedded therein with an electric circuit connected to said wire and operative to detect a change of resistance in the wire due to a crack in the blade.
- 10 2. A combination according to claim 1, in which the resistance wire is embedded in the blade so as to extend through blade areas most susceptible to cracking and in such manner that cracking in any of said areas will tend to break the wire.
- 15 3. A combination according to claim 1 or claim 2 wherein the wire extends along a peripheral region of the blade.
4. A combination according to any one of claims 1 to 3 wherein said electric circuit has
- 20 visual or acoustic means for indicating the presence of a crack.
5. A turbo-machine having a combination

according to any one of the preceding claims.

6. A machine according to claim 5 having several or all the blades of one or more stages so constructed, interconnected, and connected to one such electric circuit. 25

7. A turbo-machine having a combination substantially as hereinbefore described with reference to Figures 1 and 2 together with Figure 3 and/or Figure 4 of the accompanying drawing. 30

8. A combination according to any one of claims 1 to 4 substantially as hereinbefore described with reference to Figures 1 and 2, together with Figure 3 and/or Figure 4 of the accompanying drawing. 35

HASELTINE, LAKE & CO.,
Chartered Patent Agents,
Hazlitt House,
28 Southampton Buildings,
Chancery Lane,
London, WC2A 1AT.
Agents for the Applicants.

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COMPLETE SPECIFICATION

1 SHEET

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the Original on a reduced scale*

